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CLAIMS

(57) [Claim(s)]
[Claim 1]A cylindrical component in which thickness manufactured with resin or metal to one joy stick which can input 2 flexibility of front and rear, right and left differs, . [whether it is the elastic rod-like element which was combined with an embedded structure and manufactured, and each cylindrical component has electrical resistance, and] Or by coating a substance which shows electrical resistance to each cylindrical component, and moreover making a contact portion between each cylindrical component into structure of energization nature, An element for length detection which measures electrical resistance of the rod-like whole element, and enabled it to measure the length of a rod-like element and which made length variable up and down is combined, A three-dimensional position detecting means which enabled it to detect 3 flexibility of up-and-down front and rear, right and left, A three-dimensional input device comprising a calculating means which computes a three-dimensional position in predetermined coordinates using an output from said three-dimensional position detecting means, and an interface means which transmits an output from said calculating means to a computer.
[Claim 2]A cylindrical component in which thickness manufactured with resin or metal to one joy stick which can input 2 flexibility of front and rear, right and left differs, . [whether it is the elastic rod-like element which was combined with an embedded structure and manufactured, and each cylindrical component has electrical resistance, and] Or by coating a substance which shows electrical resistance to each cylindrical component, and moreover making a contact portion between each cylindrical component into structure of energization nature, Combine one end of an element for length detection which measures electrical resistance of the rod-like whole element, and enabled it to measure the length of a rod-like element and which made length variable up and down, and the other end of this element is combined with one more joy stick, By establishing a rotation detecting means for furthermore detecting rotation of a circumference of a rod-like element axis of said element for length detection, A 6 flexibility detection means by which it enabled it to detect a position of the three directions of up-and-down front and rear, right and left, and a total of six flexibility of a yaw, a pitch, and an angle of the three directions of a roll, A three-dimensional position [in / using an output from said 6 flexibility detection means / predetermined coordinates], A three-dimensional input device comprising a calculating means which computes a yaw, a pitch, and a roll which are the angles of deflection of a detection section in the position, and an interface means which transmits an output from said calculating means to a computer. [Claim 3]A three-dimensional input device which becomes [having made it a circuit of electrical resistance constituted with each cylindrical component in said sensing element raise the accuracy of measurement including two or more circuits in the three-dimensional input device according to claim 1 or 2, and] as a feature.
[Claim 4]An input/output device using a three-dimensional input device consisting of a three-dimensional input device given in any 1 clause and a head loading type display of Claims 1-3, and a control pad provided with two or more switches.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]More this invention about the three-dimensional input device for inputting the position or position in three-dimensional space, and a direction in details. The structure which can be used in the field of this input device and virtual reality according to change of 3 flexibility or 6 flexibility, or a game is related with the input/output device using this easy and inexpensive input device.
[0002]
[Description of the Prior Art]With improvement in the performance of the latest computer, the frequency of three-dimensional data processing, such as a virtual reality and a game, increases, and the necessity for a three-dimensional input is increasing. Drawing 20 shows the structure of the input device of 6 flexibility currently indicated by JP,H5-216583,A concerned as an example of conventional technology. The handle 51 operated by hand is connected to the plinth 53 via the six cylinders 52. Since the length of the six cylinders 52 will change if the handle 51 is operated, the position and direction of the handle 51 can be inputted by finding such length and calculating the found length. However, while the necessity for small size and the lightweight and inexpensive equipment concerned increases, from what says that six cylinders are held like the above-mentioned conventional example, the conventional thing has many which need the big plinth 53, and does not satisfy this condition.
[0003]
[Problem to be solved by the invention]While making into the thing of a small and lightweight new structure the sensing element which this invention is made in view of such a situation, and serves as an element of a three-dimensional input device, By using this length sensing element, it sets it as that purpose to provide inexpensive the input/output device using the small and lightweight input device concerned or the input device concerned in the virtual reality field.
[0004]
[Means for solving problem]In order that this invention may solve an aforementioned problem, to one joy stick which can input 2 flexibility of (1) front and rear, right and left. It is the elastic rod-like element manufactured combining the cylindrical component in which the thickness manufactured with resin or metal differs to the embedded structure, By coating the substance which each cylindrical component has electrical resistance, or shows electrical resistance to each cylindrical component, and moreover making the contact portion between each cylindrical component into the structure of energization nature, The element for length detection which measures the electrical resistance of the rod-like whole element, and enabled it to measure the length of a rod-like element and which made length variable up and down is combined, The three-dimensional position detecting means which enabled it to detect 3 flexibility of up-and-down front and rear, right and left, The calculating means which computes the three-dimensional position in predetermined coordinates using the output from said three-dimensional position detecting means, the three-dimensional input device comprising an interface means which transmits the output from said calculating means to a computer -- or, (2). [whether it is the elastic rod-like element manufactured combining the cylindrical component in which the thickness manufactured with resin or metal differs to the embedded structure, and each cylindrical component has electrical resistance in one joy stick which can input 2 flexibility of front and rear, right and left, and] Or by coating the substance which shows electrical resistance to each cylindrical component, and moreover making the contact portion between each cylindrical component into the structure of energization nature, Combine one end of the element for length detection which measures the

electrical resistance of the rod-like whole element, and enabled it to measure the length of a rod-like element and which made length variable up and down, and the other end of this element is combined with one more joy stick, By establishing the rotation detecting means for furthermore detecting rotation of the circumference of the rod-like element axis of said element for length detection, A 6 flexibility detection means by which it enabled it to detect the position of the three directions of up-and-down front and rear, right and left, and a total of six flexibility of a yaw, a pitch, and the angle of the three directions of a roll, A three-dimensional position [in / using the output from said 6 flexibility detection means / predetermined coordinates], The calculating means which computes the yaw, pitch, and roll which are the angles of deflection of the detection section in the position, the three-dimensional input device comprising an interface means which transmits the output from said calculating means to a computer -- or, (3) the three-dimensional input device which becomes [having made it the circuit of the electrical resistance constituted with each cylindrical component in the above (1) or the length sensing element in (2) raise the accuracy of measurement including two or more circuits, and] as a feature -- or, (4) The above (1) The input/output device using the three-dimensional input device consisting of any one three-dimensional input device of - (3), head loading type display, and a control pad provided with two or more switches is constituted.

[0005]

[Function]If a rod-like element expands and contracts, the contact portion between the cylindrical components of an embedded structure will change, but if extended, since the interval of a contact portion will be extended and resistance will become large, the operation of a length sensing element can measure length L of a rod-like element by measuring the resistance R of a rod-like element by a root portion. Since the error of measurement by the blur of a point of contact is not produced by considering it as the circuit of two courses, the accuracy of Measurement Division may be improved. A joy stick and the above-mentioned length sensing element are combined, the three-dimensional position as a control input of the joy stick in predetermined coordinates is calculated from the output of 3 flexibility which doubled and obtained the upper and lower sides of 2 flexibility of front and rear, right and left of a joy stick, and a length sensing element, and the result is made to input into a computer. By combining the above-mentioned length sensing element between two joy sticks, and detecting rotation of one joy stick and the angle of the move direction to this length sensing element, Detection flexibility will be increased and The position of the three directions of up-and-down front and rear, right and left, The yaw, pitch, and roll which are the angles of deflection in the three-dimensional position and position as a control input of the joy stick in predetermined coordinates operated are calculated from the output of a total of six flexibility of a yaw, a pitch, and the angle of the three directions of a roll, and the result is made to input into a computer. therefore, these -- the three-dimensional input device of many flexibility -- small size -- it can provide lightweight and inexpensive. The input/output device of an one form which consists of a control pad provided with two or more above-mentioned three-dimensional input devices, head loading type displays, and switches is constituted, and offer of the input/output device using the inexpensive three-dimensional input device concerned which can be used for a virtual reality or a game by this is attained.

[0006]

[Working example]Drawing 1 thru/or drawing 4 show the working example of the length sensing element of this invention. Drawing 1 shows the structure of a rod-like element. A rod-like element is constituted combining the cylindrical component 11 in which the thickness manufactured with resin or metal differs in an embedded structure so that it may become elastic like the rod antenna of radio. And since the length sensing element which detects change of the length by elasticity of this rod-like element is constituted, Although this length by a cylindrical component must be connected with electrical resistance change, it constitutes by using as material with electrical resistance each cylindrical component itself combined with the embedded structure as the one method. Or as shown in drawing 2, each cylindrical component is used as the cylindrical component 12 which consists of an electric nonconductor, the substance which shows electrical resistance to the surface is carried out coating 13, and it is considered as contact 14 structure of the energization nature which moreover makes this resistor 13 energize the contact portion between each cylindrical component 12. The nonconducing cylindrical component supporter 17 may be formed between the cylindrical components 12. Although drawing 3 shows the electrical connection in this working example roughly, like a graphic display, it connects the code 15 of energization nature to the tip end part 18 of the cylindrical component 11 in the end node 16, and takes [be / it / under / of the cylindrical component 11 / letting it pass] it out from the root

portion 19. Since the electrical equivalent circuit formed in a rod-like element by such connection comes to be shown in drawing 4, the resistance R will change in proportion to length L of a rod-like element. Therefore, it is measurable by measuring the resistance R of a rod-like element by carrying out detection according to length L of the rod-like element.

[0007]Drawing 6 thru/or 8 show other working examples from which it was made for the circuit of the electrical resistance constituted with each cylindrical component of the length sensing element concerned to turn into a circuit of two courses. The working example of drawing 6 is the 1st method of constituting the circuit of two courses, each rear surface of each nonconducing cylindrical component 12 is coated with the substance 13 in which electrical resistance is shown, and, moreover, as for front and the reverse side, in a table, the contact portion between each cylindrical component 12 makes back the structure of energization nature via the contact 14-1,14-2. The nonconducing cylindrical component supporter 17 may be formed between the cylindrical components 12. In the end node 16 of the tip end part of a rod-like element, coating of the resistance of a rear surface is connected and resistance between the rear surfaces of a root portion is measured with a ohm-meter. Since the electrical equivalent circuit formed in a rod-like element by such connection comes to be shown in drawing 7, the resistance R will change in proportion to length L of a rod-like element. Therefore, by measuring the resistance R of a rod-like element, detection according to length L of the rod-like element can be carried out, and it can measure. Although accuracy has only one point of contact in the above-mentioned working example about each terminal area, it exists two times two places in this example. [14-1,14-of] Therefore, since the error of measurement by the blur of a point of contact is negated and suits, it can decrease to one half by simple calculation, and can raise accuracy. The working example of drawing 8 is the 2nd method of constituting the circuit of two courses, divides the surface of a cylindrical component into two, and makes it the circuit of two courses of a left-hand side table and a right-hand side table to a figure. The equivalent circuit is the same as drawing 7, and its accuracy improves similarly.

[0008]Drawing 5 shows the working example of the 3 flexibility type three-dimensional input device of this invention. This combines the above-mentioned length sensing element 1 with the one joy stick 2 which can input 2 flexibility of front and rear, right and left. It is good to form the lever 3 at the tip of a length sensing element. As shown in drawing 9, the portion of the joy stick 2 connected the length detection means 1 to the structure 21 called the gimbal used for supporting a gyrocompass, and has connected the variable resisters 22 and 23 for detecting an angle of rotation to each rotating part of a gimbal. Therefore, if resistance of each variable resisters 22 and 23 is measured, the angle to the perpendicular direction of the direction of front and rear, right and left of a joy stick is detectable. Since the length detection means 1 is connected to the above-mentioned joy stick, if resistance of the length detection means 1 is measured, the length from a joy stick to a tip end part is detectable. Thus, a means by which 3 flexibility of up-and-down front and rear, right and left is detectable is constituted. Since it is only the resistance corresponding to the angle to the perpendicular direction, and the distance from a joy stick to a tip end part, in order to input the digital signal which expresses the three-dimensional coordinates in predetermined coordinates with a computer, a digital disposal circuit is required for direct detection being carried out here by the above-mentioned means. This composition is shown in drawing 10. First, the resistance of the joy stick 2 and the length detection means 1 is changed into voltage by the resistance voltage conversion circuit 31, then is changed into a digital signal with A/D converter 32, and is inputted into the microcomputer (microcomputer) 33 built in the three-dimensional input device. The microcomputer 33 calculates the three-dimensional coordinates of a three-dimensional input device point from the received data, and is carrying out the operation which transmits a result to the computer connected outside.

[0009]Here, the algorithm which calculates three-dimensional coordinates from detected information is explained. First, a sign is defined as follows.

a: The angle c detected from the variable resistor 23 of the outside of the gimbal of the angle b:joy stick 2 detected from the variable resistor 22 inside the gimbal of the joy stick 2 : let the center of the distance joy stick 2 from joy stick 2 center to a tip end part be the starting point.

x: coordinates y: of a longitudinal direction -- coordinates z: of a cross direction -- the formula which searches for the coordinates x, y, and z from a, b, and c by which coordinates detection of the sliding direction is carried out, Since it changes by the direction on which the joy stick 2 is put, it shall be installed like drawing 11 (that is, when an angle detection value is 0, a stick turns to the z-axis). Then, the values detected are polar coordinates of the point of the three-dimensional input device which made the center of the joy stick 2 the starting point. Therefore, it is convertible

for rectangular coordinates by the following formulas.
x=−c*sin[b]*cos[a]
y=−c*sin[a]
z=c*cos[b]*cos[a]
The built−in microcomputer 33 is transmitted to the computer to which the above calculation result is connected outside. Although the flow chart of the software which shows operation of the built−in microcomputer 33 is shown in drawing 12, the above−mentioned procedure is performed. Although the microcomputer 33 which contains the calculation for searching for the three−dimensional position of a tip end part has realized in this example, Naturally it is also possible to transmit to the computer which omits this portion and by which the detected data is directly connected to the exterior of this three−dimensional input device, and to calculate by the program in it. It is also possible to accelerate not using a microcomputer but using LSI for exclusive use. By the above composition, the three−dimensional input device of this invention, The function in which a three−dimensional position can be easily inputted into a computer by making it move to a position to specify with the lever of a tip end part is achieved, and since the structure is simultaneously simple, small size and manufacturing inexpensive lightweight are possible.
[0010]Drawing 13 shows the working example of the 6 flexibility type three−dimensional input device of this invention. This between two joy stick 2−1,2−2 which can input 2 flexibility of front and rear, right and left, The above−mentioned length sensing element 1 which has a rod−like element is combined, and the rotation detecting means 24 for detecting rotation of the circumference of the rod−like element axis of the upside joy stick 2−2 to the length sensing element 1 further is established. By fixing the lower joy stick 2−1, making it move to the position which wants to have and specify the lever 3 connected to the upside joy stick 2−2 by a user's hand, and turning in the direction to specify, A total of six flexibility of the position of the three directions of up−and−down front and rear, right and left, and a yaw, a pitch and the angle of the three directions of a roll can be inputted. About the lower joy stick 2−1 and the length detection means 1, it has the same structure and function as a case of said three−dimensional input device. The upside joy stick 2−2 has structure like drawing 14 in detail.
Measure resistance of the two variable resisters 22 and 23, and the direction of the length detection means 1 for the lever 3 is detected, It is installed in the center, and resistance of the variable resister of the rotation detecting means 24 connected to the length detection means 1 is measured, and the angle of rotation of the upside joy stick 2−2 to the length detection means 1 is detected.
Thus, the detection means of 6 flexibility is constituted. Since it is only the resistance of each resistor, in order to input the digital signal of 6 flexibility into a computer, a digital disposal circuit is required for direct detection being carried out here by the above−mentioned means. This block diagram is shown in drawing 15. The resistance of joy stick 2−1,2−2 of the upper part and the lower part and the length detection means 1 is changed into voltage by the resistance voltage conversion circuit 31, is continuously changed into a digital signal with A/D converter 32 by it, and is inputted into the microcomputer 33 built in 6 flexibility input device. A microcomputer calculates the three−dimensional coordinates in the predetermined coordinates of the lever 3 of a 6 flexibility type three−dimensional input device point, a yaw, a pitch, and the angle of deflection of a roll from the received data, and is carrying out the operation which transmits a result to the computer connected outside.
[0011]The method of calculating the three−dimensional coordinates of a point is the same as the case of a said 3 flexibility type three−dimensional input device. The yaw which remains, a pitch, and the algorithm which calculates the angle of deflection of a roll are explained. First, a sign is defined as follows. The data obtained from the lower joy stick 2−1 and the length detection means 1 follows the same definition as the above.
d:. The angle f detected from the variable resistor 23 of the outside of the gimbal of the angle e:top joy stick 2−2 detected from the variable resistor 22 inside the gimbal of the top joy stick 2−2 : The top joy stick detected from the variable resistor of the rotation detecting means 24 of two to top joy stick 2 center. angle−of−rotation p: to ********** 1 −− angle−of−deflection q: of the yaw of the lever 3 −− angle−of−deflection r: of the pitch of the lever 3 −− the formula which asks for the angle−of−deflection angle p, q, and r of the roll of the lever 3, Since it changes by the direction on which the joy stick is put, in the initial state of p=q=r=0, it shall be installed like drawing 16 (that is, when an angle detection value is 0, a stick turns to the z−axis). If the computational procedure of conversion of the coordinate system of elementary dynamics is followed, the angle of deflection to search for will be searched for by the following algorithms from

the data obtained.
(step1) Preparation [of data to a variable] c1=cos[b] s1=sin [b]
c2=cos[a],s2=sin[a]
c3=cos[f],s3=sin[f]
c4=cos[d],s4=sin[d]
c5=cos[e],s5=sin[e]
It carries out.
(step2) Calculation r12=-c4*(c3*s2*s1+s3*c1)-s4*c2*s1r22=c4*c3*c2 of the calculation h=c3*s2*c1-s3*s1 i=c4*c2*c1-s4*hj=c3*s1+s3*s2*c1 (step3) rotation matrix element of the numerical value which uses it abundantly. -Calculation $p=\tan^{-1}$ of a s4*s2r32=c4*h+s4*c2*c1r31=c5*j+s5*ir33=c5*i-s5*j (step4) angle of deflection [-r12 / r22]
$q=\tan^{-1}$ [r32/sqrt[r12**2+r22**2]]
$r=\tan^{-1}$ [r31/r33]
However, the range which takes the angle of function $\tan^{-1}$ [y/x] is defined as follows.
$t=\tan^{-1}$ [y/x]
x> It is 0<=t<= 90[degree] at the time of =0 and y>=0.
It is 90 < t < 180[degree] at the time of x< 0 and y> 0.
Time 180<=t<=[0 / x<=0 and / y<=] 270 [a degree]
x> It is 270 < t < 360[degree] at the time of 0 and y< 0.
It carries out. The built-in microcomputer 33 is transmitted to the computer to which the above calculation result is connected outside. Although the flow chart of the software which shows operation of the built-in microcomputer 33 is shown in drawing 17, an above-mentioned procedure is performed. Although the microcomputer 33 which contains the calculation for searching for the three-dimensional position and angle of deflection of a tip end part has realized in this example, Naturally it is also possible to transmit to the computer which omits this portion and by which the detected data is directly connected to the exterior of this three-dimensional input device, and to calculate by the program in it. Accelerating using LSI for exclusive use is also possible. By the above composition, this three-dimensional input device of this invention, It can be made to be able to move to a position to specify with the lever of a tip end part, and by turning in the direction to specify, 6 flexibility can be easily inputted into a computer, and from the structure being simultaneously simple, it is small and lightweight composition and can manufacture inexpensive.
[0012]Drawing 18 shows the working example of the input/output device which used the three-dimensional input device of this invention. This is what installed the above-mentioned 6 flexibility type three-dimensional input device 42 between the head loading type display (HMD) 41 and the control pad 43, and the head loading type display 41 is supported with the ring 44 covered over the shoulder so that it may bring close to a user's eye and can install. The user can see the image of a big screen before an eye by looking into the head loading type display 41. The fundus of the three-dimensional input device 42 is connected to this head loading type display 41, and the point is connected to the control pad 43. Therefore, the head loading type display 41 and the control pad 43 will be connected by the three-dimensional input device 42. The control pad 43 is equipped with two or more switches. The working example of the input/output device using this three-dimensional input device is constituted for the purpose of using it for a virtual reality or a game. The scenery from the cockpit of an airplane is displayed on the head loading type display 41, the position of the control pad 43 and rotation can be transmitted to a computer with the three-dimensional input device 42, and an airplane can be made to fly as an example of concrete directions in the case of a flight simulator. The direction of a missile or a laser rifle can be made to specify by inclination of the control pad 43 similarly as another example in the case of a shooting game. The three-dimensional input device 42 can manufacture inexpensive with small size, a light weight, and composition small [an integral-type input/output device / that it is such], since it is inexpensive, and lightweight, the use area of 6 flexibility input is spread, and use in a virtual reality or a game is also attained. In the above working example, even if it changes to the three-dimensional input device of 3 flexibility of this invention which described above the three-dimensional input device 42, an input/output device is realizable similarly. Both are chosen by free frequency required for application.
[0013]Drawing 19 shows other working examples of the input/output device which used the three-dimensional input device of this invention. The equipment 45 which includes the control device of the head loading type display 41, a power supply, etc. in a user's waist is fixed, the head loading

type display 41 is fixed to the face so that a user may be seen, and the 6 flexibility type three-dimensional input device 42 is installed among these both. This integral-type input/output device is used for a virtual reality. That is, since the position and direction of a face are detected and it is transmitted to a computer by the 6 flexibility type three-dimensional input device 42 when a face is moved, a picture changes according to it and the user can experience virtual space. Although the expensive magnetic sensor is conventionally used in the field of the virtual reality, an inexpensive system can be manufactured by using the three-dimensional input device 42 of this invention.

[0014]

[Effect of the Invention]By considering it as rod antenna-like structure with the cylindrical component of an embedded structure new as a length sensing element, forming two circuits for the circuit of the electrical resistance by a cylindrical component, and making the circuit of electrical resistance into two courses further, While a detection means to bring about a light weight and precision improvement is obtained, it can manufacture inexpensive. And the advantage of this length sensing element is efficiently employed also in the three-dimensional input device using this length sensing element. The inexpensive input/output device which can be used for a virtual reality or a game can be provided by combining this three-dimensional input device with a head loading type display.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a figure showing the structure of a rod-like element of making the important section of the working example of the sensing element of this invention.
[Drawing 2]It is a figure explaining the connectable state between the cylindrical components in the working example of the sensing element of this invention.
[Drawing 3]It is a schematic view of the electrical connection in the working example of the sensing element of this invention.
[Drawing 4]It is an electrical equivalent circuit figure of the working example shown in drawing 3.
[Drawing 5]It is a schematic view of the appearance of the working example of the three-dimensional input device (3 flexibility) of this invention.
[Drawing 6]It is a figure explaining the connectable state between the cylindrical components in the working example of 2 circuit sensing element of this invention.
[Drawing 7]It is an electrical equivalent circuit figure of the working example of 2 circuit sensing element of this invention.
[Drawing 8]It is a schematic view of the electrical connection in other working examples of 2 circuit sensing element of this invention.
[Drawing 9]It is an explanatory view of the composition of the joy stick used for the working example of this invention.
[Drawing 10]It is an electric diagram of the working example of the three-dimensional input device of this invention.
[Drawing 11]It is a figure showing the arrangement about the predetermined coordinates of the working-example equipment of the three-dimensional input device of this invention.
[Drawing 12]It is a flow chart of processing of the detection value in the working example of the three-dimensional input device of this invention.
[Drawing 13]It is an appearance schematic view of the working example of the three-dimensional input device (6 flexibility) of this invention.
[Drawing 14]It is a figure showing the related composition of the top joy stick of the working example of the three-dimensional input device (6 flexibility) of this invention, and a length sensing element.
[Drawing 15]It is an electric diagram of the working example of the three-dimensional input device (6 flexibility) of this invention.
[Drawing 16]It is a figure explaining the arrangement about the predetermined coordinates of the working-example equipment of the three-dimensional input device (6 flexibility) of this invention.
[Drawing 17]It is a flow chart of processing of the detection value in the working example of the three-dimensional input device (6 flexibility) of this invention.
[Drawing 18]It is a schematic view showing the composition of the working example of the input/output device using the three-dimensional input device of this invention.
[Drawing 19]It is a schematic view showing the composition of other working examples of the input/output device using the three-dimensional input device of this invention.
[Drawing 20]It is a schematic view of the conventional three-dimensional input device (6 flexibility).
[Explanations of letters or numerals]